ELECTRICAL SCIENCE.

Execution by Electricity.

IN view of the new law of the State of New York, doing away with hanging, and the substitution of electricity as the means of execution, a committee was appointed by the Medico-Legal Society to consider the best method of carrying the law into effect. The committee consisted of Dr. Frederick Peterson, Dr. J. Mount Bleyet, R. Ogden Doremus, and Dr. Frank H. Ingram. The committee submitted its report on the 14th inst.

The committee first mentions the experiments made by the commission appointed by the governor to examine into the various methods of causing death. These experiments consisted in placing dogs in a zinc-lined box, partly filled with water, one pole of the dynamo being the coating of the box, the other being a wire wound around the dog's nose or inserted in his mouth. Death was certain and instantaneous, but no data were obtained as to the potentials or currents used. During the summer, experiments were carried out at the Edison laboratory on a number of dogs; and it was shown that an alternating current of 160 volts was sufficient to kill a dog, and that with a continuous current a much higher voltage was necessary. The report proceeds as follows: —

"The average resistance of the human body is about 2,500 ohms. The most of this resistance is in the skin. It is evident, therefore, that the larger the surface of the electrode applied to the body, the greater will be the resistance. It is also a fact that the density of the current depends upon the superficial area of the electrode. A pole of small diameter will hence meet with less resistance, the passing current will be more intense, and the resulting current strength will be greater, than when an electrode of large sectional area is employed."

These statements are not correct; but, before referring to them further, we will summarize the rest of the report. The committee goes on to state that "there can be no doubt that one electrode should be in contact with the head," and recommends that the other be placed in the neighborhood of the spine. To practically carry this out, it proposes that a helmet, containing one electrode, be fitted on the head of the criminal, and he be bound to a table or in a chair, the other electrode fitted so it will impinge on the spine between the shoulders. "The electrodes should be of metal, not over an inch in diameter, somewhat ovoidal in shape, and covered with a thick layer of sponge or chamois-skin. The poles, and the skin and hair at the points of contact, should be thoroughly wetted with warm water. The hair should be cut short." An electromotive force of not less than 3,000 volts should be used, preferably alternating.

In criticism of this report, it should be remarked, in the first place, that the statement, that, because the greatest resistance of the human body is in the skin, "the larger the surface of the electrode applied to the body, the greater the resistance," is directly opposed to fact. The larger the electrode, the *smaller* will be the resistance, and this fact would point to a comparatively large electrode being used.

Again: it is not evident that one of the poles should be applied to the head. It is probable that very little of the current would penetrate the skull and pass through the brain, and that the greater part would pass through the tissues between the skin and the bone. It is probable that a current passing from one arm to another, traversing the vicinity of the heart, would be much more certain in its action than by the plan proposed, with the additional advantage that it is very easy to make contact with the arms. In almost, if not all, the fatal accidents that have occurred, the current has passed in this manner; and by insuring good contacts, and employing 3,000 volts, the results would be reasonably certain. As for the current through the head, we have no data as to the effects produced.

Finally, if the criminal is to be executed according to the plan proposed, the electrodes should be moistened with acidulated or salt water, not simply warm water. The only good feature of the report is in the potential recommended. An alternating current of 3,000 volts would in all probability kill the criminal, however it happened to be introduced.

A SNOW-STORM ON AN ELECTRIC ROAD. — On Friday, Nov. 9, St. Joseph, Mo., was visited by one of the most severe snow-storms in the history of the city. According to the *Daily Gazette*, "the big storm completely paralyzed business, and shut this section of the country off from communication with the world. The snow which fell was of the damp variety, and at 2 o'clock in the afternoon the loaded telegraph and telephone wires began to break under the pressure. Then the heavy electric-light wires began to fall, and at 4 P.M. every thing was demoralized. Many telephones were burnt out, and the entire system of the city was rendered practically useless." Speaking of the cars on the Sprague Electric Street-Railroad, the *Gazette* continues, "There were present all the conditions which it was feared might impair the usefulness of the new motor, but not the least inconvenience or delay resulted. With the use of two-fifths the capacity of the plant, the usual number of cars were operated, and made the usual time. And not only did the storm illustrate the reliability of the electric motor, it also showed that the Union Passenger Railroad line people made no mistakes and did no poor work in constructing their line. Not a wire was broken down, nor was any other defect in the appliances developed. Telegraph-wires were down in every direction, and the telephone-wires of the city suffered great damage; but the wires on the Union Railway line stood the test without the slightest damage."

PROTECTING IRON AND STEEL BY ELECTROLYSIS. — The methods at present in use for the prevention of oxidation of steel and iron have all the same object, namely, the formation of a coating of magnetic oxide of iron; but all of them are more or less unsatisfactory. Considerable time is usually required, and there is no certainty that the protection will be perfect. M. de Méritens has been experimenting for some time on an electrolytic method of obtaining the same result, and has finally been successful. *Industries* describes the process as follows: "The article is exposed to a current of electricity in a bath consisting of ordinary water, or, better, of distilled water, heated to 70° or 80° C. The object to be coated is made the anode, while a strip of carbon, copper, or iron serves for the cathode; or, if an iron tank is used, the sides of the tank may form the cathode. The current should only have an electro-motive force slightly in excess of that required to decompose water, as too strong a current produces a pulverulent form of the oxide, which does not properly adhere; moreover, it has the inconvenience of eating into polished surfaces. The operation should be conducted in the same manner as electrotyping. In the course of a few minutes, black coloration appears on the article, and after one or two hours the coating of magnetic oxide of iron is of sufficient solidity to resist polishing. The coating is found to penetrate into the mass of the metal; for if the external portion be removed by means of emery, and the white under surface be again exposed in the bath, it becomes black again almost immediately, demonstrating that the effect of the first electrolyzing has affected the mass to some depth. When a piece of rusty iron is treated by the current in a warm-water bath in the manner described, the rust, consisting of ferric oxide, is completely converted into magnetic oxide. The exterior layers are not adhesive, but the interior coating is almost as hard as the metal itself. The best processes employed hitherto for coating steel goods require at least eight or ten days, and only imperfect results are obtained when applied to wrought or cast iron. De Méritens's process treats all sorts of iron and steel effectually in a few hours, requires no preliminary preparation, and can be applied as easily to rough as to polished surfaces. The coating is a brilliant black, is very hard, and it is difficult to attack it with lime; moreover, it is not easily wetted by water.

BOOK-REVIEWS.

On the Senses, Instincts, and Intelligence of Animals, with Special Reference to Insects. (The International Scientific Series, No. LXIV.) By Sir JOHN LUBBOCK. New York, Appleton. 8°.

SIR JOHN LUBBOCK'S varied, valuable, and interesting contributions to science have gained for him a high place among anthropologists and biologists as well as scientists in general. He is an eminent example of the union of ingenuity with painstaking compilation and wide observation that has distinguished so many

Englishmen of science; notably, Darwin, Francis Galton, E. B. Tylor, G. J. Romanes, and others. This reputation is sufficient to secure for any production of his pen wide and careful attention, and to make a notice of its contents a serviceable task. The present volume has more about it of the spirit of the compiler of scientific memoirs than of the ingenious experimenter and the popular writer. A very large share of the work is given over to an anatomical description of the sense-organs of the lower forms of life, and to a discussion of their probable mode of functioning. A bibliographical reference-list of 215 numbers shows how diligently the details have been compiled; and yet the general impression with which one comes away from this portion of the work is, that, in spite of all the work and study, our information is extremely vague and defective. Strange as it may seem, in studying the lower forms of sense-organs it becomes difficult to distinguish between an eye and an ear, an organ of taste, smell, and touch. Our own experience with sense-organs so entirely disposes us to think of the sensations of other animals as essentially similar to our own, that it is difficult for us to realize how different they may be. Not alone are there "animals which have eyes on their backs, ears in their legs, and sing through their sides," but the very sensations thus denoted may really be quite other than in ourselves. Between the highest vibration that we can hear as sound and the lowest that we can see as color, there is an immense gap, which may be only partially present to the senses of other animals.

It would be impossible to indicate here the contents of the richly illustrated descriptions of sense-organs, the enormous variety of their nature and development, their peculiar adaptations to the requirements of the environment. Nature has more than one solution for many of her problems; and the different forms of sense-organs form her answers to the problem of adaptation of physiology to physics. The eye, especially, seems to be a very cheap product; the re-action to light being well established in plants, and the forms of optic organs obtaining an enormously complicated variety in insects. Anatomists have discovered much, but physiologists have done little to give meaning to these discoveries. The method promising best results is the comparison of normal individuals with individuals deprived of a presumable sense-organ. Forel, for example, finds, that, while normal ants will always avoid ultra-violet rays, ants with their eyes varnished are no longer able to distinguish between this and other colors.

Following the chapters upon the anatomy of sense-organs and a chapter upon 'Problematical Organs of Sense,' come chapters upon 'Bees and Colors,' upon 'The Limits of Vision in Animals,' upon 'Recognition among Ants,' upon 'The Instincts of Solitary Wasps and Bees,' upon 'The Supposed Sense of Direction,' and upon 'The Intelligence of the Dog.' Much of the matter here treated has already been published in other shape. It is a *résumé* of points upon which experiments have been made rather than a systematic compilation. The accurate distinction of colors by bees, the connection of this color-sense with the fertilization of flowers, are quite familiar. The limits of vision in animals is a point still deeply in dispute. In answer to the question whether the thousands of ants in one nest, always recognizing one of their own number, but remorselessly attacking all strangers, do so by a smell peculiar to the community, or by a password, the observations seem to say that neither explanation gives complete satisfaction, but further experimentation may clear up its mysteries. The peculiar instincts of wasps and bees, now paralyzing an enemy with all the skill that knowledge of its anatomy could give, again providing for the nutrition of its offspring with a foresight apparently mathematical in its exactness, make us marvel and reflect. Nor is our contemplation made clearer when we observe that this same wise bee has not sense enough to fill up a hole made in her honey-cell, but for an entire afternoon, and more, pours in honey at the top, only to have it flow out of the bottom like the vessel of the Danaides. The wonderful sense of direction ascribed to insects proves, upon careful inquiry, to resolve itself into a moderately successful but by no means infallible or direct appreciation of environment. The final topic, the intelligence of the dog, deserves a further word. In it Sir John describes his attempts at teaching his dog, Van, to express his wishes by language. A large number of cards are printed with such words as 'food,' 'tea,' 'water,' 'bone,' 'out,' and so on, upon them; and by a system of rewards Van has learned to associate his desires with the visual shapes of the letters. When he wants water, he brings not only at command, but spontaneously, the placard bearing that word. This certainly is a noble achievement, and opens up vast possibilities. Quite discouraging, on the other hand, are the attempts to teach the dog to bring a colored card to match the color presented to him. This was diligently taught him again and again, but Van seemed never to get a clear notion of what was desired. 'Can Animals Count?' is the last point treated in the volume, and the question largely resolves itself into determining how large a number of objects can be and the withdrawal of one be noticed. Many animals (birds, etc.) can doubtlessly distinguish between four and five, but no more definite statement can be hazarded. A curious observation is that given by Mr. Huggins concerning his dog, which can apparently perform wonderful mathematical calculations by watching the expressions (all unconscious) of his master, — a valuable hint for telepathy.

All in all, then, the present volume is a convenient and well-compiled reference-book on animal psychology, but is destined to be superseded, as our knowledge advances, by one with fewer gaps and fewer confessions of ignorance. It treats of a fertile field the true importance of which has only recently begun to be realized. A rich success awaits him who has the ingenuity to devise, and the patience to carry out, real successful methods for testing the mental powers of the mute creation; who can decipher these animal hieroglyphics, or force the unwilling sphinx to yield up its enigma.

Works of Thomas Hill Green. Vol. III. *Miscellanies and Memoir.* Ed. by R. L. NETTLESHIP. New York, Longmans, Green, & Co. 8°.

THIS is the concluding volume of Green's works, and consists of essays on a variety of topics, with a sketch of his life by the editor. The memoir is well written, and, for philosophical readers, interesting, though the life of such a man is necessarily lacking in the outward incident characteristic of a more stirring career. The editor, therefore, takes occasion to give an account of Green's views on philosophical and practical subjects, and to indicate to a certain extent the sources in his own character and in the writings of others from which they were derived. Green, as is well known, was an Hegelian; and, though he did not accept all of Hegel's views, the familiar catchwords of the Hegelian philosophy perpetually recur in his writings. The present volume, however, is not all, nor even mainly, devoted to philosophical themes, but contains papers, and some of considerable value, on history, education, and other subjects in which the author was interested. The principal philosophical paper is on 'Popular Philosophy in its Relation to Life,' and is a vehement attack on the English school of thought, especially as represented by Hume. It shows an irritability that is to be regretted, and probably most readers will think the author's own views quite as far from the truth as those that he criticises; but, as illustrating a certain phase of current philosophical thought, the paper is of interest. Several of these 'Miscellanies' are on religious themes, and show the attempts that Green made to adapt the Christian dogmas to his own philosophy, — attempts, as it seems to us, but very slightly successful. For instance: his theory of God is one that makes him no God at all in the view of Christianity or of any other existing religion. He expressly says that God is nothing but the ideal self, the possible perfect man that each of us ought to become; and there is no reconciling this doctrine with the teachings of Christianity.

But, however peculiar may have been his religious views, his interest in moral improvement, both personal and social, was deep and strong. Some of the most interesting passages in the volume before us are those in which he shows his sympathy for the poor, and his desire for their moral and intellectual elevation. He was dissatisfied with existing English society, consisting of the educated few and the uneducated many, and he warmly advocated the extension and improvement of the common-school system as the only practicable means of removing the evils he deprecated. He regarded common education as "the true social leveller," and looked for the time when "the sort of education which alone makes the gentleman in any true sense will be within the reach of all." Besides papers on the various subjects above alluded to, this volume contains a series of lectures on the English Revolution of the seven-